Title: The Development of Real-Time Physiological Monitoring and Training Software for Remote Applications

RE: Final Report, Cooperative Agreement # NNA04CK16A

`Autogenic Feedback Training Exercise (AFTE) is an protocol and technology developed by Dr. Patricia Cowings and her associates at NASA Ames Research Center as a means to facilitate astronaut adaptation to space and exposure to the microgravity. AFTE is a training method which involves teaching subjects to voluntarily control several of their own physiological responses to environmental stressors. As the procedures matured, the training program was expanded to determine if technology developed to facilitate astronaut adaptation to space would be valuable in treating patients suffering from autonomic and vestibular pathologies and symptomatic relief from nausea and/or blood pressure control anomalies such as hypo- or hypertension.

The present study, performed in conjunction with Morehouse School of Medicine, Biomedical Engineering at The University of Akron and NASA Ames Research Center has demonstrated that this technology can be successfully applied over vast distances. The specific purpose of this research was to develop a PC based system which could handle processing of twenty channels of acquired physiological data in addition to the necessary duplex communication protocols that would, for example, permit a patient in Atlanta, GA to be trained by a clinician stationed in San Jose, CA.

Tasks completed under this Agreement include the following:
Acquisition of sixteen (16) channels of physiological data that include..

1 Skin Conductance Level (SCL)
2 Skin Temperature (Temp)
3 Respiration
4 Electrocardiogram
5 Left Finger Pulse
6 Right Finger Pulse
7 Left Toe Pulse
8 Right Toe Pulse
9 Left Arm EMG
10 Right Arm EMG
11 Left Leg EMG
12 Right Leg EMG
13 Arterial Oxygen Level
14 Arterial Blood Pressure
15 Transthoracic Impedance (dz/dt)
16 Transthoracic Impedance (Zo)

The 16 channels of physiological data are acquired via a Dataq® DI-720 Data Acquisition Module running Windaq® acquisition software[1] The 16 channels of analog

[1] Dataq Instruments, Akron, OH 44333

data are processed in a PC running the AFTE-Server Software. The twenty (20) channels of processed data include..

1. Skin Conductance Level
2. Skin Temperature
3. Respiratory Rate
4. Heart Rate
5. Left Finger Pulse Volume
6. Right Finger Pulse Volume
7. Left Toe Pulse Volume
8. Right Toe Pulse Volume
9. Right Arm EMG (rms)
10. Left Arm EMG (rms)
11. Right Leg EMG (rms)
12. Left Leg EMG (rms)
13. Systolic Blood Pressure
14. Diastolic Blood Pressure
15. Mean Arterial Pressure
16. Stroke Volume
17. Cardiac Output
18. Total Peripheral Resistance
19. Thoracic Fluid Volume
20. Vagal Tone

Data from the 16 analog channels and 20 digital displays are transmitted via the Internet to the remote clinician running the AFTE-Client Software. The complete digital ensemble is shown in Figure 1